SPEED INTENSIVE PRODUCTION AS A DEVELOPMENT STRATEGY:

The Case of the Electronics Industry in Taiwan

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ABSTRACT

Taiwanese firms are the worldwide manufacturing leaders of electronic components and personal computers. The government and the private sector foster Research and Development to enhance technological advancement in the country. Thus, to exemplify the great emergence of the electronics industry in Taiwan, this paper aims to determine whether the speed intensive production model is the main variable to describe the sector's great rise. Specifically, it tries to understand whether cheap mass production has been the main comparative advantage.

To test the initial hypothesis that speed intensive production led to the development of electronics in the country, I conducted a deep research through literature reviews as well as relevant information from scholars at National Taiwan University. The results show a small effect of such a production model in the current industry's scenario.

All in all, speed intensity cannot explain the whole transition for Taiwanese electronics firms to be that highly positioned in the market. The strong tie with China, the influence of giant technological firms and the period of economic liberalization are more likely to respond to the strategic path followed by Taiwanese companies.

KEY WORDS

Electronics, strategy, business, government, investment, outsourcing, production and development.

RESUM

Les empreses Taiwaneses són les líders mundials en producció de components electrònics i d'ordinadors personals. El govern i el sector privat promouen l'àmbit de la Recerca i Desenvolupament per millorar l'avenç tecnològic al país. Així doncs, per tal d'exemplificar el sorgiment de la indústria electrònica a Taiwan, aquest treball té com a objectiu determinar si la producció en velocitat intensiva és la variable principal per descriure el gran creixement del sector. Específicament, tracta d'entendre si la producció barata i en massa ha sigut el principal avantatge comparatiu.

Per ficar a prova la hipòtesi inicial de si la producció intensiva en velocitat comporta el desenvolupament de l'electrònica al país, he dut a terme una recerca en detall a través de revisió de literatura així com d'informació rellevant d'acadèmics de la Universitat Nacional de Taiwan. Els resultats mostren un efecte menor d'aquest model de producció en l'escenari industrial actual.

Considerant-ho tot, la velocitat intensiva no explica completament la transició de les empreses electròniques Taiwaneses per arribar a estar tant altament posicionades al mercat. L'estret lligam amb la Xina, la influència de grans empreses tecnològiques i el període de liberalització econòmica són més propenses a respondre el camí estratègic seguit per aquestes empreses Taiwaneses.

PARAULES CLAU

Electrònica, estratègia, empresa, govern, inversió, subcontractació, producció i desenvolupament.

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I. INTRODUCTION

1.1. Justification

Development strategies are complex topics which intrigued my attention due to the intuitive view required to make them succeed. I believe those plans of action are ways that can make scholars understand how relevant some specific factors are to explain a broader issue. Thus, I am interested in getting to know the procedures emergent economies deal with to grow as well as the reason why some of them have better success rates compared to others.

During the study of this paper, I participated in an exchange program at National Taiwan University (NTU). I have always been interested in Asian culture and I could not miss the opportunity to live in Taipei for one semester. I wanted to benefit from that location to have a closer and more personal experience on this field of study. In this way, I could take advantage of the local perspective by doing an accurate and analytical research. Furthermore, one of the subjects I was enrolled in is named *Market and Economic Development of Taiwan*. My professor Kelly Olds gave me some guidelines on which economic sectors could explain in detail the development of Taiwan. Moreover, his knowledge on the field made it easier to identify a clear topic to study.

Therefore, the electronics industry is the sector I analyse because it apparently is an explanatory variable of the extraordinary transition Taiwan has gone through. I believe electronics can give a proper explanation to the current situation of the Taiwanese economy as it is still one of the most important industries. Yet, there should have been some adaptation processes along the way which would have enabled this country to become a leader in the world market for electronic devices. Furthermore, it may be difficult to outstand in such a competitive market nowadays. The technological sector surely requires to have a rapid response due to the quick changes in demand.

On the other hand, this thesis has a strong relation with my field of study. International Business and Economics are strongly correlated to understand how the Taiwanese economy deals with this strategy. Furthermore, the leading electronics enterprises based in the country, such as Foxconn, are a good representation of a long-lasting strategy made by the private sector, which turned to be adaptable, innovative and profitable. Yet, there may be some costs left behind to lead the market and to get substantial benefits.

All in all, I believe this topic is of academic interest due to its original approach. Yet, I should say that I would not have been able to study it in detail without the references Mr Olds shared with me. Besides, I could not have left Taiwan without writing my thesis about this island. It was a great experience for me to temporarily live there and I hope this paper is of great interest for all the readers as well.

1.2. Objective and scope of the project

The objective of this paper is to study how speed intensive production helps to explain the leading role of the Taiwanese electronics industry worldwide. As the topic of my research is related to development strategies in emerging economies, I analyse the reasons why this production model would have led Taiwan with a comparative advantage amongst others. Furthermore, I will apply it to a business case to understand the challenges private agents face and to what extent the initial production model is still preserved nowadays.

From a personal view, I would like to test my skills as a researcher in order to give a proper reasoning to this case of study. My goal is to make a realistic, coherent and personal analysis on how this speed intensive production model can be a key factor to develop the electronics sector in Taiwan. Yet, if there are some limitations I cannot prove, I encourage other researchers to study it as thoroughly as I will.

1.3. Hypothesis

The questions I would like to answer in this paper will be related to the process of adaptation regarding speed intensive production in the Taiwanese electronics industry. Is it a determinant variable to explain the success of some private firms in electronics? Which reasons made the country to invest in this field? Are there some negative externalities? What are the current strategies followed by the private agents leading this international market?

These are some references that guide me during this research and they will have their respective answer throughout the study of this paper. Yet, my initial hypothesis is that Taiwan's speed intensive production model is the main cause to explain the development of electronics industry.

1.4. Theoretical framework

The literature review of my research is strongly contrasted with Kelly Olds' lectures regarding the development of Taiwan's economy. There is one chapter focusing on the electronics industry, while there are others about international finance or investment that helped me reaching a better understanding about the whole topic. Moreover, I take some references from lectures of Mr Weatherall, my professor of Political Science, which are useful for deepening into the topic and to be more critical.

It is of great importance to take all these notes because they are useful for an analytical view of my hypothesis. They are primary and reliable sources of information that have been

fundamental to write this paper. On the other hand, I am taking reference of other authors, beyond NTU's academic research, who studied different cases related to the electronics industry in Taiwan. Their insights are very useful to explain the transition the Taiwanese industry has experimented. Moreover, their understanding in the field gives me a broader perspective and knowledge to be prepared for Foxconn's business case.

For instance, according to Fuller (2003), there are four important factors for Taiwanese technology firms to become innovators. He defines this term as the ability to create the next generation of product or process technology. Firstly, Fuller says that producing manufacturing-based products can play into the strength of the Taiwanese electronics industry. Secondly, a high volume of production is achievable as no customization is required. In fact, the major part of electronic products demand a systematic way of production. Thirdly, a high level of granularity in the production chain is necessary as technology devices can be produced independently. This affirmation goes along with the benefits electronics enterprises have through vertical disintegration. Finally, Fuller argues that a large amount of patient capital is not required to innovate. Production can commence directly after setting up the factory. Indeed, it is important not to expect long-term gains due to the unpredictable changes that may occur in the technological market.

On the other hand, Lin and Chang (2009) debated on whether a country should foster an industry in which it has a comparative advantage. This case of study accords with Lin's argument that the government and firms within a country should follow their strengths to increase national competitiveness and economic sustainability. Economic clusters promote competitive domestic markets regardless of their size as long as they serve in the global market. Lin argues that the key strategy for developing countries, like Taiwan once was, is to compare with other States having similar factor endowments and to look at what products could allow Taiwan to grow economically and to promote innovation and research. In that way, any country can move up in the industrial scale, moving from labour intensive industries to capital intensive ones.

Yet, Taiwan has followed some steps that Chang defends in this debate. For instance, he states that an optimal level of targeting is required depending on the specific circumstances of a country. A developing country needs to accumulate a certain amount of capital and human resources in order to produce what is the best at, but taking into account time and government interventions as key elements to allow this progress. Furthermore, deviations from the comparative advantage can be also compatible with economic development. You do not just need to simply stick to a country's comparative advantage. This argument defends that the theory of comparative advantage is not wrong on itself, as countries should specialize in what they are best at doing. Yet, the process of industrial development is too complex to just be guided by such a narrow theory.

Moreover, following Stan Shih's smiling curve (see annex figure 1), manufacturing would add the least value to a product -which normally makes it vulnerable to low bargaining power- and, consequently decreases profit margins. However, with speed intensive production it can be argued that this is may not be the case as the manufacturing process is systematized and not necessarily capital demanding. This characteristic could improve the Taiwanese companies' negotiating position. Yet, Shih's approach also states that marketing, branding or sales adds more value to a product. This theory could be applicable to the low visibility of Taiwanese enterprises in the global value chain, lacking from international recognition. This can imply smaller profit margins as well as a lower bargaining power respect to their main technological contractors.

This statement is related to the production chain in which Taiwanese electronics firms participate. They usually work as suppliers for other giant technological firms. Indeed, this interdependence in the global value chain is related to an economic theory named the Great Unbundling. Such concept related to globalization was discussed in my Trade Theory subject, taught by ByeongHwa Choi, at National Taiwan University. This theory argues that the First Unbundling implied the end of making goods close to its point of consumption due to, for example, the reduction in transportation costs. Besides, the Second Unbundling implies the end of performing most manufacturing stages near to each other due to, for instance, a reduction in communication and coordination costs. This evidence is also known as vertical disintegration of production across borders.

The argument in favour for the fragmentation in production claims that firms become more productive. While the tasks that enterprises are best at doing remain onshore, other tasks can be done in a cheaper way abroad. In fact, international competition is nowadays happening not just at an industrial or firm level, if not at a task level. Assembly, packaging or data entry can be of great importance for Taiwanese firms to outstand against competition. In addition to that, Grossman and Rossi-Hansberg (2007) argue that the easiness to trade a particular task is variable. An activity that seems safe today, may not be it in the future due to foreign competition. Besides, the tradability of a task nowadays, like producing electronic chips, is not a matter of skill. External variables, like power relations between agents in the electronics market, make it difficult to identify the winners and the victims of the global value chain.

1.5. Methodology

To construct the argumentation of this paper, I have read research journals and books from the System for Library Information Management –just provided to students and academic staff- in the NTU Virtual Campus or at the Main Library itself. This platform allowed me to download

documents available for university students who are doing some research. Indeed, the descriptive part of this thesis was initiated with two highly recommended readings from Mr Olds. These are "Leading, Following or Cooked Goose? Innovation Successes and Failures in Taiwan's Electronics Industry" (2003) and "Taiwan's PC Industry, 1976-2010: The Evolution of Organization Capabilities" (2014). Yet, more updated sources of information were needed to understand the chronology and to get the whole picture of the subject.

On the other hand, official data, graphs and statistics of Taiwan's economy are considered to study the current relevance of the electronics sector. This information is provided by the Public Administration, like the National Development Council. Moreover, I took advantage of Kelly Olds to give me some advice regarding the electronic sector and the advantages it has brought to Taiwan's economy. Furthermore, the notes taken in lectures by such professor have been of essential need to get to know his thoughts on some topics. They serve as a contrast of information as well as to bring more critical thought towards this case of study.

Moreover, this thesis is supported by an analytical framework of the events that affect the current scenario in the electronics industry. Once the research on the development strategy of electronics industry in Taiwan is studied, the author interprets whether the theoretical framework is related to the current business context. Foxconn's case will serve as the example of challenges some Taiwanese firms face nowadays and how they deal with foreign competition. And, most relevantly, it is relevant to argue whether speed intensive production is a key element of this industrial progress.

Finally, this case of study could explain another side of the story. There may be some externalities affecting Taiwanese enterprises like offshoring, unemployment or unethical business practices. Therefore, if my goal is to discuss a development strategy, I believe some hidden costs can also arise from this apparent success story. In this way, it is of great importance to discuss the pros and cons of leading the world supply of electronic components.

II. THE ECONOMIC DEVELOPMENT IN TAIWAN

2.1. After the wars

After the Chinese Civil War and the Second World War, from 1950s to 1970s, Taiwan began to develop into a capitalist economy in agriculture and light industry, supplemented by the public sector, heavy industry growth and local investments (Jaw and Wang, 2018, p.86). Its economy was considered as dual, with the sectors closed to the government having a better access to finance than the Small and Medium Enterprises (SMEs) owned by entrepreneurs (Olds, 2020).

By that time, Taiwan entered in a period of cold war with China. Chiang Kai-shek was the leader of the country and his aim was to recover Mainland China from the communists. There was a period of tense stability as both parts agreed that Taiwan was part of China. Yet, the economy was still under control by the Kuomintang party – with Chiang Kai-shek as the ruler- in case another conflict could occur (Olds, 2020).

The post-war recovery in Taiwan is traditionally known as the transition from an agricultural economy to an industrialized one. Therefore, the idea is that Taiwan started to export agricultural products and to buy manufactured goods from abroad. Afterwards, the country would apply an import substitution policy by replacing those imports through domestic production. This is also related to the infant industry policy in which a developing country protects its market to grow up and later produces high-quality manufactured goods (Olds, 2020).

On the other hand, it is relevant to mention the role the United States had in Taiwan's recovery. Indeed, in 1951 the American aid supposed the 10% of national GDP (Olds, 2020). It was a way for Taiwan to offset the large military budget due to the cold war with Mainland China. But, most importantly, it was a key factor for Taiwan to strengthen domestic production. Yet, that external aid was turning into trade deficits that were slowing down Taiwan's self-sufficiency.

Thus, the 1950s was a period in which Taiwan finally closed itself to allow infant industries to learn how to produce under some external aid. Subsequently, in the 1960s –when the aids cut off- the government realized the importance of autonomy. This is the period when the public authorities allowed the market to steadily open up under controlled trade. Yet, the government was still suspicious about international transactions (Olds, 2020).

2.2. The early monetary and fiscal policies

During the transition from an agricultural to an industrialized economy, Taiwan's government did no longer rely on borrowing that much from abroad. The public sector was quite

conservative and preferred to hold their own savings to sustain the economy. That ideology affected the starting point of electronics industry by focusing on granular production. It also implied the inability to succeed in segments in which patient capital was needed as there were few external aids. In fact, Taiwan's financial system was not set up to sustain high amounts of long-term capital investment. Therefore, private firms needed to innovate in a way that did not consume large quantities of capital with the hope of long-term returns (Fuller et al., 2003, p.181).

This financial characteristic can be explained by historical reasons. There was fear by the government of big businesses' influence as well as inflation. According to Park (2000), the Kuomintang regime viewed large enterprises as a threat for the financial system due to the concentration of capital in private hands. There was a government desire for monetary stability and the public administration kept a balanced budget until the 2000s (Olds, 2020).

In addition to that, following Field's argument (1997), Taiwanese loans always had positive real interest rates even for firms connected to the State. Consequently, their debt-to-equity (D/E) ratios were at very low levels since the early 1970s (Fuller et al., 2003, p.192). This characteristic was also affected by the limitations the government imposed on credit subsidies. While countries like South Korea borrowed a large amount from government banks, it was rather limited in Taiwan (Olds, 2020).

But, although there were few credit loans from the government banks, informal credit markets appeared. This was the other side of the coin, which indirectly was accelerating the economy as well. For instance, there were rotating credit associations, in which people of trust reunited and made a lot of money between themselves. There were also post-dated checks, which consisted in postponing the day you paid back your loan. In case you did not, you could be arrested and go to prison. On the other hand, there were secret backrooms in Taipei's jewelry stores. Those did not sell much jewelry, instead they mainly did some hidden business like borrowing and lending with domestic currency (Olds, 2020). Therefore, Taiwanese population managed to make some profits and incentivize the local economy despite the government's credit restrictions.

Back to the 2000s, the Taiwanese electronic firms were no longer the SMEs they used to be. The government got less conscious with the balance budget. There was some deficit spending and the private enterprises expanded in the search for narrow segments to maximize their returns (Fuller et al., 2003, p.193). Nonetheless, the starting point of electronics industry in Taiwan was to innovate in sectors that did not require a vast amount of investment. Later, they increased in size and dominated larger segments of the international market.

2.3. Process of production in the Electronics Industry

2.3.1. *1960s*

Since the 1960s, the Taiwanese government realized that electronics would be an important sector in the forthcoming years. Therefore, they perceived that making a business strategy could be a source of economic growth. After discussing several options with foreign exports and organizing a team of Taiwanese Americans involved in the semiconductors industry, one of the measures the Taiwanese government did to start such a process was signing an agreement with RCA Electronics (USA) to transfer CMOS technology[1]. Yet, the Electronics Research Service Organization (ERSO), the Industrial Technology Research Institute (ITRI), the Ministry of Economic Affairs (MOEA), the Science and Technology Advisory Group, government officials, technical universities and some of the State-owned banks also cooperated to promote this specific industry (Fuller et al., 2003, p.181).

The result was the construction of the first chip packaging factory by a US company named Microchip (Tsai and Cheng, p. 8, 2006). This enterprise set up Kaohsiung Electronics in the Kaohsiung Export Processing Zone in 1966. Interestingly, foreign investors were attracted by the cheap Taiwanese female labour force that was useful for packaging the chips (Olds, 2020).

Moreover, there was an interest to attract back some talented Taiwanese people living in the US. The goal was to offer more training in major technical universities in order to promote innovation on their own and leave behind technological dependency on foreign licensing (Fuller et al., 2003, p.182). Without this interest in the Integrated Circuit (IC) industry by the government, private SMEs would not have been able to access the sector as the technological barriers were very intimidating for their size (Mathews, J. and Dong-sung, C., 2000).

2.3.2. *1970s*

The ITRI was the main driver for industry success by that time. Several projects were conducted, such as the creation of Taiwan United Microelectronics Corporation (UMC), which proved that the country could actually mass-produce. Afterwards, a "Very Large Scale Integration" project was made. The result was a 6-inch fabrication laboratory which led to the establishment of the Taiwanese Semiconductor Manufacturing Company (Tsai and Cheng, 2006, p.7). This period focused more on the actual design of production rather than packaging.

[1] "Complementary Metal Oxide Semiconductor". It is a technology used to produce integrated circuits. They are found in several electronic components such batteries or digital cameras (TechTerms.com, 2017).

Furthermore, foreign companies did more quality control and branding on the chip-based products in order to improve quality (Olds, 2020).

Yet, according to Olds, there was a poor performance by the government during that decade. The industry lacked from organization and capital equipment as the factors of production available were inferior than the necessary ones. Furthermore, the main problem in the industry was the dependence on foreigners for marketing.

Nevertheless, these weaknesses are common for speed intensive production. The market changes very fast due to technological advancement. Therefore, the factories did not have time to make a proper organization plan. They were using task-specific capital as, in few months, new trends could emerge. Consequently, quality control was not emphasized because there was a lot of subcontracting to manufacture as much as possible. Due to the quick time response, other manufacturers were hired to produce alternative electronic pieces (Olds, 2020).

2.3.3. *1980s*

Back in the 1980s, foreigners started to associate Taiwan with high-tech of producers of chips and computers. The government supported more the industry and pushed for offering better services. There was also a transition from labour-intensive products to capital-intensive ones (Jaw and Wang, 2018, p. 87). Furthermore, there were a lot of electronic assemblers that increasingly attracted foreign investors. Therefore, infrastructure still needed to be improved due to the increment of capital accumulation.

The government's response was to create a special district that could ensure the requirements of the emergent electronics industry. Thus, the main plan was the creation of Special Economic Zones[2] that could ensure the take-off. Furthermore, the government created a ten-year plan on the production of information goods, mainly on computers (Olds, 2020).

A globalised production system was emerging in the international markets, leading to several manufacturing procedures around the world. Taiwan took its opportunity to position in the global supply chain by an understanding of the government and manufacturers of the electronic trends that were rising. By that time, most of the worldwide PCs were already Taiwan-made but branded by multinational companies (Tsai and Cheng, 2006, p.5).

[2] A Special Economic Zone (SEZ) is a country's area subject to unique economic regulations that differ from other regions of the same country. They tend to attract higher Foreign Direct Investment, receive higher tax incentives and pay lower tariffs (Barone, 2019).

2.3.4. *1990s*

As it can be seen in figure 2 (see annex), by the 1990s, Taiwan was in a stage of knowledge-intensive industries and advanced high-tech. This was the period when the country's electronics industry reached a leading world-wide position. Taiwan was capital-intensive and had a higher focus on innovation. Furthermore, foreign trade became an important pillar (Jaw and Wang, 2018, p.87).

Besides, the electronic industries developed their own memory technology. It was at this moment when Europe, America and Japan started to value Taiwan's strength and were willing to negotiate projects for technological transfer. For instance, the first ventures between Taiwanese and foreign companies emerged (Tsai and Cheng, 2006, p.8).

On the other hand, the government launched another ten-year plan on computer applications. Yet, it did not work as other countries were more efficient in software. Moreover, the role of the government became less influential as the electronics enterprises grew internationally. For instance, the 90s-government plan aimed to expand the global IT market share from 1,9% to 3,1% by 2000. Yet, the plan was already achieved in 1991 (Olds, 2020). Therefore, the industry was going on its own while the government seem to no longer have a clear idea on how fast the industry emerged.

2.3.5. *2000s*

In the 2000s, lots of foreign investment was made in the electronics sector. The technical level improved as there was a higher focus on training personnel. Moreover, the number of sales increased and the country reached the fourth position in worldwide semiconductors supply, producing around the 12% of the global chip market. Incredibly, the sales revenue was 50 times higher than in the 1990s (Tsai and Cheng, 2006, p.8).

It could be considered as the period of enterprises' own path in R&D and the passive role of the government concerning the private sector. The public administration could no longer have measurable goals because they realized how impossible it was to predict what would happen in 10 years' time. However, they still set up new research centres in Taiwan for IC design and software (Olds, 2020).

2.3.6. *2010s*

By 2010, Taiwanese companies captured more than one-quarter of the global integrated-circuit (IC) market share. They were the biggest producers of flat-panel displays in the world and supplied more than 90% of global laptop shipment volume (Yu, H.H. and Shih, W.C., 2014, p.329).

Yet, while Taiwanese firms remained the leaders in component's supply, they still lacked from branding and marketing capabilities. However, they had the technical know-how, proper manufacturing process and big size. Even so, those companies focusing on design integration and miniaturization faced better than others (Yu, H.H. and Shih, W.C., 2014, p.356). Over time, competition between firms moved to efficiency under large production scale.

Consequently, speed intensive production played its role in the electronics sector, being relevant for the assembly of PCs and smartphones. Nevertheless, Taiwanese electronic companies have done so behind the scenes. They surely have improved their technique and quality control over time. Yet, these fast-electronic assembly lines, although having a symbiotic relation with bigger technological companies, do not have as much bargaining power and recognition.

III. THE ESTABLISHMENT OF THE ELECTRONICS INDUSTRY IN TAIWAN

3.1. A development strategy

Olds (2020) argues that scholars usually identify the development of a country by the following steps of the chain: labour-intensive, capital-intensive, technology-intensive and services. Yet, not all countries necessarily need to follow such a path to emerge. For instance, he thinks that Hong Kong's economy grew by labour-intensive goods and transformed it directly into the service sector. On the other hand, some authors believe that producing technology is necessary for using it later. Yet, Olds does not think there is a causality. For example, Taiwan produces a lot of hardware with mass production while India is better at software and, therefore, focuses more on the service sector. At the end, Taiwan went from labour-intensive production to technology-intensive under high speed.

In fact, according to Olds (2020), even before the 1950s, there were sectors that already adapted to speed intensive manufacture. For instance, the hat industry applied this production model to adapt to the quick changes of the market. Fast reaction time was more important than getting low costs. The quality was not as good as other foreign products though. But, this Taiwanese industry got benefits by being the first to adapt to the new hat styles and export those goods to the West.

On the other hand, this production model coincides with the theories some authors defend to outstand in the industry. For instance, Weill (1993) claims that IT infrastructure should be flexible to be able to handle increased customer demands without increased costs. Barney (1991) argued that a firm will only obtain a sustainable competitive advantage above its competitors if products have the following 4 characteristics: valuable, rare, inimitable and non-substitutable. Yet, the Taiwanese firms opted for manufacturing electronic components under an efficient production strategy. Hence, rather than assembling an inimitable product, they managed to find a creative way to manufacture in emerging fields through mass production and low selling prices. This core strategy would add value to their products and gave them some advantage respect to competition.

In fact, technological capability is also an important determinant to promote the competitive advantage of firms. Firms integrating technological advances can drive productivity growth, have higher levels of efficiency and be more innovative (Jaw and Wang, 2018, p.87). The Taiwanese enterprises took advantage of technological trends in the electronics industry by finding a production process which could be suitable for their own industrial structure and amount of capital (Fuller et al., 2003, p.180). Despite having a SME-heavy industrial structure, the Taiwanese entrepreneurs used to pursue niche products with success (Fuller et al., 2003, p.194).

That has been a key factor to respond to market challenges and to achieve a high product differentiation.

However, none of these plans would have been reached without the secondary role of the government in the sector, mainly during the eighties. The public policy was focused on providing technical support. But, most importantly, they managed to provide the necessary resources such land, water and electricity to support the activity in the value chain. For instance, institutes like ITRI executed the government's premises. Those were mainly focused on research and design, as well as the provision of technology from the most sophisticated countries (Tsai and Cheng, 2006, p.21).

According to Wang and Chiu (2014), the electronics industry has also benefited from the cooperation between the public and the private sector. There was a precise government policy making, the bridging of institutions and the establishment of public infrastructures to facilitate its functioning. These factors promoted the establishment of high-quality industries, like the semiconductor. The procedure was partly achieved due to the initiative of the government, which focused on investing in foreign capital and transferring foreign technology in Taiwan. Yet, the private sector also played their role by redesigning the industry. It was the main contributor to bring electronics to the global industry (Tsai and Cheng, 2006, p.21).

Yet, other countries like Japan and South Korea also developed their own strategies to be leaders in the electronics industry. For instance, Japan kept safe the domestic market through protectionist measures. On the other hand, South Korea opted for large conglomerates, called *chaebols*, to develop their industries (Tsai and Cheng, 2006, p.3). Yet, it should be considered that, contrary to Taiwanese financial structure, large conglomerates also implied a high indebtedness for the economy due to its big capital requirement.

Another reason that explains the country's formation in the electronics industry is the educational system. It has a strong focus on engineering applied to design and manufacturing. The deep understanding from professionals in this field led Taiwan to pursue this technological sector. For instance, there are three major science parks in the country: Hsinchu Science Park, Central Taiwan Science Park and Southern Science Park. Nowadays, more than 60% of Taiwanese cities have science parks, contributing to business networks of the electronics industry. Its major effect has been a gradual improvement of technological capabilities, interconnection, learning, competition and cooperation (Jaw and Wang, 2018, p.88).

Eventually, and most relevantly, there has been an improvement in productivity efficiency leading to economic growth. Taiwanese electronic businesses did not profit from their technological skills, but from their quick response time (Olds, 2020). Besides, the entrepreneurial spirit of the Taiwanese supported the industrial progress by a leadership value of *"better being*

the head of a chicken than the tail of a horse" (Tsai and Cheng, 2006, p.3). All these macro and micro factors joined together fuelled the development of the sector.

3.2. Relevance for the economy

Starting from assembly, the electronics industry started by the transfer of Japanese companies -coming in before the wars- and the Taiwanese workers doing the labour-intensive goods. Yet, as the electronics sector is in constant change, the industry moved to quick response to market products on time (Olds, 2020). That was the main advantage electronics factories had to emerge. Later, more international firms hired Taiwanese electronics components to finish their goods. Therefore, the sector grew in importance until it turned to be the main industry of the country.

According to Lin et al. (2006), the electronics industry in Taiwan has definitely contributed to the economic development of the country. In fact, this industry has been widely recognized as the key factor for economic growth. Nowadays, Taiwan's electronics industry is the most competitive supplier in the international market. The ongoing globalization process and low selling costs are one of the causal effects (Hou, 2019, p.8). Yet, not only the electronics industry is relevant in Taiwan for its exports but for the contribution to national Gross Domestic Product (GDP). Taiwan's strong position in semiconductors lets the country to seize a high number of business opportunities (Jaw and Wang, 2018, p.90).

As shown in figure 3 (see annex), since the 21st century the Electronic Parts and Components Manufacturing (EPCM) –in which speed intensity takes place- represents the 33,79% of total export volume, adding up a total amount of 107,20 USD (billion). On the other hand, IC products represent the 29,10% of total exports and accounted for 92,31 USD (billion) in 2017. This graph represents how important electronics industry is in Taiwan, as around 62,89% of exports corresponded to this specific sector three years ago.

One year before, Taiwan's IC products were ranked as the second worldwide, right after the United States and surpassing Japan and South Korea. Indeed, they were ranked in first position for packaging, testing and computer products. Besides, according to the Ministry of Economic Affairs, the semiconductors industry and IC design were also considered as the second best ranked worldwide (Jaw and Wang, 2018, p.89).

For instance, as shown in figure 4 (see annex), the semiconductor industry value in Taiwan improved from 2011 to 2017. During these 6 years, the industry's growth has more than doubled compared to the world one, except from 2017. This positive pattern seems to stagnate in 2017 although there is still a positive rate. While the Taiwanese increase was of 3,50%, the world one accounted for 11,50%. This downward pattern in percentage could exemplify the

advanced development stage for Taiwanese electronic components, as high growth rates were already achieved before the global market.

In fact, some authors argue that the semiconductor enterprises are facing a congestion stage regarding technological progress due to delays and higher production costs. According to Jaw and Wang (p. 90, 2018), just 3 of them would continue to grow nowadays: the Taiwanese Semiconductor Manufacturing Company (TSMC), Samsung and Intel. TSMC, the local enterprise, is expected to be a large-scale manufacturer in 5 nanometres chips for this year 2020, being a major innovator in this field.

IV. CURRENT SCENARIO

4.1. Data analysis from 2019

According to Hou (2019, p.12), the Taiwanese electronics industry is currently divided in 7 sectors: semiconductors, optoelectronics, computers and peripherals, electronic components, communication networks, electronics channels and other electronics.

But, to get a general perspective on the whole sector, I examine this chapter through the statistical graphs from Taiwan's Statistical Data Book (2019). For instance, in graph 1, it can be seen several products out of which Taiwan is one of the 3 biggest producers and their respective global market share. As represented, Integrated Circuit (IC) foundries are the first-ranked in the global market, owning the 75,6% of the market share in production value. Moreover, the industry is improving its packaging and testing, which are very important to increase the added-value for the chips. In this case, the market share is 55,80% in production value as well.

Therefore, it can be interpreted how Taiwan's electronics industry is crucial for its economy. Not just in chips production, but in the granular manufacture for PCs. The country is leading the production of motherboards, with the highest global market share in production of 84,80%. Even the country occupies the first position in the production value of other gadgets like cables CPE, WLAN, DSL CPE, PND and mobile device optical lens. Another important point is the second position in IC design, being more fragmented than others, with a 17,00% of market share in production value.

In my opinion, taking the lead in manufacturing, testing, packaging and design is the safest option Taiwan can do to re-establish its leading position as an electronics component supplier in the long run. However, the government and the private sector have already improved to a large scale these production stages through time. In fact, as discussed in chapter 3, some authors state that Taiwanese firms dominate the market shares in these tasks. That's the reason why I also think that branding, marketing or sales is crucial to innovate in the future.

Furthermore, these final production stages can lead to higher international recognition and to add extra value to their products. At the end, I believe it is important to be recognized by consumers as a valuable brand as it can allow an enterprise to increase its profit margins through higher selling prices. But, as the merchandise from Taiwanese enterprises does not usually end to a final consumer, it could allow them to increase bargaining power instead. That would be useful to negotiate in front of giant technological firms that may be interested to get some of their electronic pieces.

On the other hand, it is remarkable that Taiwan has the highest market share for production volume of notebooks and desktop computers, with a 78,70% and 51,10% respectively. Yet, I

would have never guessed that before as I did not know the country was a pioneer in this field. Perhaps, and according to Shih's theory of smiling curve (see annex figure 1), Taiwanese firms still need to work on marketing to add more reputation to their computer sector. This strategy may not affect the profits of domestic corporations. But, I do believe having a worldwide recognition in high-tech can help Taiwan in the political affairs or even to increase tourism. To defend my opinion, I would be in accordance with Nye's concept of soft power. This political theory describes the ability to shape the preferences of others in an indirect way. Accordingly, a worldwide visibility of Taiwan as a high-tech country could possibly have positive spillover effects to other sectors inside the country and to their diplomatic relations with other States.

Graph 1: Products of which Taiwan was among the World's Three Largest Producers in 2018.

1. Including Offshore production.

(1) Production value.

(2) Production volume

1st Place Worldwide (18 Items)				2nd and 3rd Place Worldwide	
Items	Taiwan's Global Market Share	Items	Taiwan's Global Market Share	Items	Taiwan's Global Market Share
1. Motherboards (1)	84.8	14. High-end bicycles(2)	33.4	-- 2nd Place Worldwide (9 Items)	
2. Cable CPE (2)	83.2	15. printed circuit	29.9	1. servers(2)	35.4
3. golf club heads(2)	81.5	boards(1)		2. TFT-LCD panels (>10") (1)	30.8
4. notebook computers (2)	78.7	16. ABS(2)	28.7	3. TFT-LCD panels (<10") (1)	27.1
5. IC foundries(1)	75.6	17. instant noodles(2)	22.0	4. IC substrates(1)	26.0
6. WLAN (1)	68.1	18. tea drinks(2)	17.3	5. TPE(2)	19.5
7. DSL CPE (2)	66.1			6. ball screw(1)	18.7
8. IC packaging and testing (1)	55.8			7. IC design(1)	17.0
				8. silicon solar cells(2)	11.0
9. desktop computers(2)	51.1			9. PTA(2)	8.7
10. functional textiles(1)	51.1				
11. PND (1)	47.9			-- 3rd Place Worldwide (1 Items)	
12. mobile device optical lens(1)	46.4			1. monosodium glutamate(2)	8.9
13. Copper Clad Laminate(2)	43.4				

Source: Industrial Technology Information Services (ITIS) Program.

Graph 2 is a representation to prove how Taiwan's production in electronics has moved from labour intensive to capital intensive manufacturing. There has been a very big change in the distribution of factors of production nowadays compared to the industrial boom this country had during the second half of the twentieth century. There is less supply of labour in

manufacturing because the factories do no longer need as many people as they used to. Labour intensive manufacturing is located in South-East Asia, but mostly in China. Taiwan has kept the capital-intensive manufacturing because its economy has reached a higher development stage. A reason to understand this process is on how human capital has been better educated and there are more professionals working in engineering or science.

This table shows how, from 2001 to 2018, the degree of intensity in factors of production for commodities has changed. For instance, exports of high capital intensive products have risen. In 2018, Taiwan exported advanced capital intensive products by a 61,00%, compared to the 36,80% in 2001. This effect can be caused by an improvement in the production capacity of the electronics industry. Consequently, there is less manufacture of labour intensive goods compared to the capital ones inside the territory.

Accordingly, the degree of exports for high labour intensity commodities has slowly reduced from a 30,50% to a 27,60%. This depletion can be understood as an improvement of production capabilities due to a technological effect which requires less workforce.

Graph 2: Standard and Characteristic Classification of Exported Commodities (By intensity of Input Factor)

Period	Total	Degree of Labor Intensity			Degree of Capital Intensity			Degree of Technical Intensity			Degree of Energy Intensity		
		High	Mid	Low	High	Mid	Low	High	Mid	Low	High	Mid	Low
2001	100.0	30.5	43.1	26.4	36.8	56.8	6.4	55.9	29.8	14.3	20.7	47.9	31.4
2002	100.0	31.2	42.6	26.2	40.0	54.2	5.8	57.1	29.8	13.1	21.1	46.4	32.5
2003	100.0	32.0	43.4	24.6	45.3	49.3	5.4	57.7	30.7	11.6	22.3	45.8	31.9
2004	100.0	32.4	43.5	24.1	50.9	44.4	4.6	58.3	31.4	10.3	23.8	45.5	30.6
2005	100.0	32.3	43.1	24.7	55.2	40.5	4.2	57.8	33.0	9.2	26.1	44.7	29.1
2006	100.0	31.9	43.9	24.3	59.5	36.6	3.9	59.6	32.0	8.3	25.8	46.9	27.4
2007	100.0	32.3	41.6	26.2	61.9	34.4	3.7	59.0	33.3	7.8	28.2	44.7	27.2
2008	100.0	32.3	39.9	27.8	62.3	34.0	3.7	57.2	35.5	7.2	30.3	42.7	27.1
2009	100.0	30.7	43.7	25.6	61.5	34.7	3.8	59.5	33.3	7.2	28.4	45.8	25.8
2010	100.0	31.6	43.4	25.0	62.0	34.5	3.5	60.8	32.6	6.6	27.6	45.0	27.5
2011	100.0	30.1	43.7	26.3	60.4	36.0	3.6	59.1	34.3	6.5	28.7	44.8	26.5
2012	100.0	30.2	43.2	26.6	61.0	35.2	3.9	57.7	35.4	6.9	29.2	45.7	25.1
2013	100.0	29.2	44.1	26.8	62.5	33.7	3.8	58.7	34.5	6.8	29.4	45.9	24.8
2014	100.0	29.7	45.7	24.6	62.2	33.9	3.9	59.4	33.5	7.1	27.8	48.3	23.9
2015	100.0	31.8	49.0	19.2	58.8	36.9	4.3	60.4	31.9	7.7	23.9	51.9	24.2
2016	100.0	30.3	51.9	17.8	59.5	36.5	4.0	62.2	30.5	7.3	22.7	54.8	22.5
2017	100.0	28.3	53.7	18.0	60.8	35.5	3.7	63.0	30.0	7.0	22.7	55.8	21.5
2018	100.0	27.6	53.0	19.5	61.0	35.3	3.7	62.4	30.5	7.0	24.2	55.6	20.3

Source: The Ministry of Finance, R.O.C. Online database of Ministry of Finance, R.O.C.

Taiwanese enterprises are switching production because the market changes rapidly due to technology advancement. There are new technological trends and inventions going on in short periods of time. Therefore, it could be argued that Taiwanese firms do not opt for a vast capital requirement due to rapid changes in demand. They may prefer to be ready, flexible and capable of changing their production line if necessary. In this way, less task-specific capital equipment is used because they would just invest it for relatively short production cycles.

Graph 3: Investment in Taiwan from Overseas Chinese and Foreign Nationals by Industry (1952-2018). Unit: US$1000

Industry	Total		Overseas Chinese		Foreign	
	Cases	Amount	Cases	Amount	Cases	Amount
Total	53,951	166,935,175	3,216	4,204,135	50,735	162,731,040
1. Agriculture, Forestry, Fishery and Animal Husbandry	201	211,803	73	28,057	128	183,746
2. Food, Beverage, and Tobacco Manufacturing	900	2,142,003	127	74,701	773	2,067,302
3. Textile Mills	251	860,546	76	225,997	175	634,549
4. Chemicals	1,081	7,881,118	121	108,263	960	7,772,855
5. Rubber and Plastic Products Manufacturing	647	1,362,224	153	64,382	494	1,297,842
6. Non-metallic Mineral Products Manufacturing	370	3,975,950	105	299,650	265	3,676,300
7. Basic Metal and Fabricated Metal Manufacturing	1,291	5,267,643	118	133,593	1,173	5,134,050
8. Machinery and Equipment Manufacturing	1,645	6,191,285	84	69,329	1,561	6,121,956
9. Electronic Parts and Components Manufacturing	3,221	28,534,355	30	18,470	3,191	28,515,885
10. Computer, Electronic and Optical Products	1,768	7,258,944	38	58,692	1,730	7,200,252
11. Electrical Equipment Manufacturing	1,544	6,466,418	179	161,751	1,365	6,304,667
12. Construction	1,086	1,841,036	174	143,671	912	1,697,365
13. Wholesale and Retail Trade	16,457	17,452,432	313	103,006	16,144	17,349,426
14. Transportation and Storage	693	1,852,832	102	201,736	591	1,651,096
15. Accommodation and Food Services	3,500	2,286,148	469	122,754	3,031	2,163,394
16. Information and Communications	3,021	8,030,494	39	64,031	2,982	7,966,464
17. Finance, Insurance and Real Estate	6,427	47,895,284	203	1,446,745	6,224	46,448,539
18. Professional, Scientific and Technical Services	4,743	7,161,400	308	606,125	4,435	6,555,274
19. Others	5,105	10,263,260	504	273,182	4,601	9,990,078

Source: Investment Commission, Ministry of Economic Affairs, R.O.C., *Statistics on Overseas Chinese & Foreign Investment, investment from the Mainland China Area, Outward Investment, and Investment to the Mainland China Area*, April 2019.

In the third graph, it can be observed the importance of foreign investment in the electronics industry. For instance, the Electronic Parts and Components Manufacturing stands out as the second industry with the highest inflow of money coming from abroad. Those $28.534.355 suppose a 17,10% of total foreign investment in Taiwan. In the case of Computer, Electronics and Optical Products, foreign investment accounts for $7.258.944, which is a 4,40% of total inflow. Even the Electrical Equipment Manufacturing supposes an investment of $6.466.418,

which is the 3,90% of total. After all, just the electronics industry sums up one-fourth of FDI received in the country.

All in all, through these national statistics I argue that Taiwan has reached such a high position by searching niche markets and innovating in this field during the end of the twentieth century. By analysing this data, it is unquestionable to state the international dominance and high market share Taiwan has as an electronics component supplier or as a producer of PCs, among others. However, I believe the private sector could apply new strategies related to marketing and sales to obtain better results in the future.

4.2. Prospects

Modern-day Taiwan has two academic disciplines above the others in electronics: computer science and medicine. In these two academic fields, Taiwan is among the best of the best in the world. But, what really distinguishes Taiwan from the rest is the merging of these two fields: Medicine and Technology. MedTech might be the future of Taiwan's high-tech export economy. Medical Technology uses artificial intelligence (AI) to improve the efficiency and reliability of the health care system. The MedTech industry is projected to grow annually almost 5,60% at least the next 4 years – by 2024 the industry will be worth almost US$600 billion-. It is needless to say that the niche and the potential of the MedTech industry is enormous for Taiwan, who is a pioneer in this field.

The Tsai Ing-wen administration –from the DPP party, which will be later discussed- has introduced a 5 + 2 Industrial Innovation Plan, where MedTech is also noted. The government has backed up venture capitalists' investments that have had a big impact in gaining capital for enterprises. The MedTech industry in Taiwan has attracted well-known companies -such as Acer, who launched AI-based flu forecasting software together with the Ministry of Health-, but also new vibrant start-ups have arisen in the industry. One of them is iXensor. This company has developed – being first in the world – a way of utilizing medical examinations by using smartphone cameras. This technology, to which they have a patent, is called PixoTech.

On the other hand, the government policies have created favourable conditions for venture capital inflow. Multinational companies like Microsoft, Amazon, IBM and Yahoo are all investing in R&D centres in Taiwan. Stan Shih's (2014) predictions on profit moving from manufacturing to R&D is accurate in contemporary Taiwan as the future of Taiwanese electronic industry lies in high-tech development and exports of these innovations, such as the ones in the MedTech industry. In fact, many of Taiwan's successes in the electronics industry have begun as international technology transfers where foreign firms from the United States

and Japan provide the initial knowledge for the Taiwanese firms to then further innovate upon as well as the firms' initial business. This has been the case for the semiconductor industry.

However, that crucial technology transfer that caused the semiconductor manufacturing industry to be born in Taiwan is currently much smaller than before as foreign firms nowadays often select lower-cost mainland China over Taiwan to fulfil their manufacturing needs. This trend makes a future in which the electronics industry rests on the manufacturing of new kinds of hardware less feasible. Thus, with the increased cost of manufacturing, it makes sense going forward nowadays for Taiwan to focus more on the software side of the electronics industry. Without the high cost of physical capital associated with setting up manufacturing plants, less patient capital would be required.

Furthermore, there are many niche areas within software such as Fintech and cybersecurity, which could allow Taiwan to granulize and specialize in a specific area, further lowering patient capital requirements. However, one possible barrier to a future in which Taiwan is an innovator in the software and AI sector is the decreased intellectual exchange with Silicon Valley and the brain drain of science and engineering PhDs moving to the United States and China. In fact, in the period between 2012 and 2015, a 75% of Taiwanese students with American PhDs chose to remain in the United States rather than to return in Taiwan. Despite these obstacles, with the rise of lower-cost electronics manufacturing in mainland China, it will almost be necessary for Taiwan to diversify from a sole focus on hardware manufacturing and take the step into the higher value-added, R&D-based software industry in order to not get left behind.

Back to the 2000s, Taiwanese corporations lacked patient capital and opted for new opportunities through speed intensive production, creating narrow segments in which their limited funds could turn into the maximum possible returns. Therefore, Taiwanese "Mini-Tech" is still an example of a development strategy in electronics which has resulted in big firms like the Taiwanese Semiconductor Company (TSMC), an example of innovation and technological capability. Even the White House contacted TSMC for building semiconductor foundries in the United States. Possibly, it is a way for Apple, one of its biggest clients, to reduce costs in its assembly line. However, what cannot be taken for granted is that the Taiwanese electronics industry has a consolidated international reputation yet.

Finally, comparing the examples of the past and future global trends, I see MedTech, specialized software development and semiconductor manufacturing as the possible pathway forward in Taiwan's electronics industry if they foster the value-added stages of their production lines (see annex figure 1). This strategy could give Taiwan an opportunity to finally consolidate as the biggest supplier of electronic components worldwide.

V. FACTORS INFLUENCING THE OUTSPREAD OF THE TAIWANESE SPEED INTENSIVE PRODUCTION MODEL

5.1. Beyond the traditional view

According Olds (2020), old books usually state that the economic boom in Taiwan is due to the production of labour-intensive goods. Yet, I agree with his idea that this kind of production has existed for a long period elsewhere. It is very difficult for a country that started its industrial development later than others to just use its labour force as a comparative advantage against competitors. Therefore, there should have been some uniqueness in the production model affecting the electronics industry which clearly made a difference.

Taiwan's success story can be explained from a further point than the import substitution policies applied by the government during the liberalization of the economy. Indeed, speed-intensive trade was something Taiwan was already good at –like the case of the hat industry-. And, after World War II, such model rose even more by simple things like international air travel. The international transaction of goods was eased by a better network of transport. It was easier to move somewhere and to negotiate in person. Moreover, international phone services improved communication by making it fast. Another big change was container shipping in the South East Asian sea as it could carry more weight and it was cheaper (Olds, 2020).

Ultimately, the traditional view on Taiwan's economic development would argue that the government's enlightened policy and guidance created the economic miracle. Thus, the businessmen and labourers were in need of the guidelines from the public-sector elite to play their role. Yet, I would defend, agreeing with Old's point of view, that the government's main role was to keep order and to let the entrepreneurs emerge. As I previously argued in the fiscal and monetary policy chapter, there was an informal credit market going on in Taiwan and, such creativity, was also raised by the citizens. Government policy is very important for a country but it may be overemphasized. The external factors, like globalization, also had a positive influence towards the new trade moves of private agents.

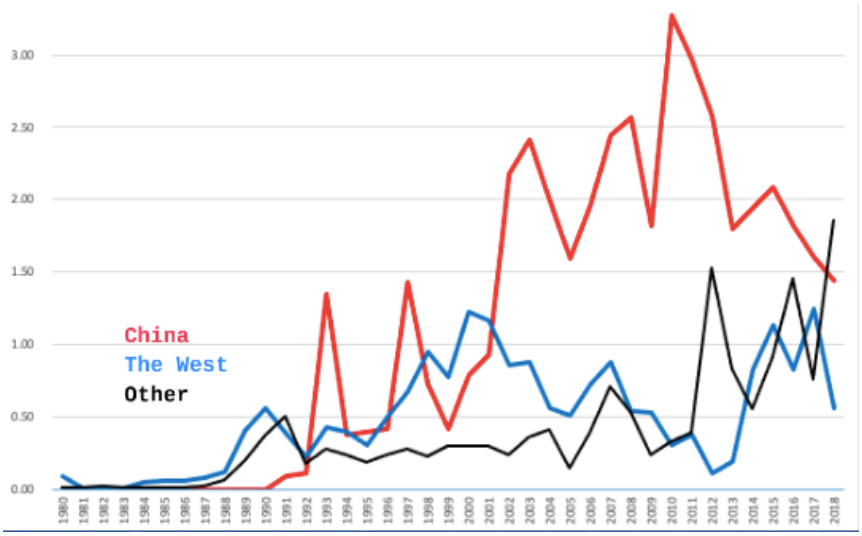
5.2. Outsourcing

The textile and electronics industries were the most important at the end of the twentieth century in Taiwan. They both reached a certain maturity stage, supposing the reduction of labour intensive commodities due to the rise of labour costs. Indeed, according to Hsing (1999, p.104), between 1984 and 1987, labour costs rose by 84% in Taiwan while other Southeast Asian competitors remained from 4 to 6 times lower. That's one of the reasons why some

Taiwanese entrepreneurs opted for offshoring, to reduce production costs and to be competitive enough to trade those goods in the international market.

Furthermore, the appreciation of the New Taiwan dollar by 30% against the US dollar during the mid-eighties eased such decision (Hsing, 1999, p.104). The agreement known as the Plaza Accord supposed the depreciation of the US dollar against other currencies because foreign countries were just accumulating dollars as reserves but not investing. The US administration made Taiwan, among other countries like Japan, to accept the deal and to appreciate its local currency.

Graph 4: Taiwan's Outward FDI in % per GDP.



Source: Kelly Olds, Prezi named Some Finance & Investment. Subject of Market and Economic Development of Taiwan, 2020.

During the late eighties, prices in Taiwan got more expensive and the government suggested businesses to move to South East Asia and to invest internationally. By that time, China was opening up its economy and it was very attractive for Taiwanese entrepreneurs to move to a place where they shared the same language and had great business opportunities. However, as it can be seen in graph 4, in Taiwanese records does not appear any proof that domestic firms were moving to China in the beginning. Yet, according to Olds (2020), this evidence exists from the Chinese records.

Apparently, most of the legal FDI initially went to the West and South East Asia. But, until 2011, the investment in other Asian countries does not really grow. In general, during the last decades, Taiwan chose China as the place to invest internationally. But, from 2013 on, the country has diversified its investment to be less dependent from China. It is proved in graph 4

the tendency of Taiwanese FDI towards other locations than China during the last years. According to Olds (2020), nowadays the big area of investment for Taiwanese firms is Vietnam.

After all, American, European, Japanese and Korean technology multinationals accelerated outsourcing of manufacturing due to the benefits it supposed compared to their development stage. This phenomenon is associated with the term "second unbundling", used in trade theory. This concept deals with how globalization affects the business models and transaction of goods between countries. The second unbundling implies the separation in fragments of the assembly lines, which can also be named as "vertical disintegration". Therefore, as globalization advances, it is easier to move task-specific production in several places. The highly competitive market encouraged Taiwanese firms to find new places where they could expand their production lines with less restrictions and lower costs.

The second unbundling is applicable to this case of study. Nowadays, private enterprises assemble different parts of an electronic product without the need of territorial unity. Yet, from the speed intensive production model perspective, it is easier to establish the whole network in the same space. Consequently, electronic firms can easily adjust production by subcontracting others nearby and quickly adapt to market changes. Therefore, I believe the Taiwanese electronics industry benefits from the second unbundling as a supplier of finished goods. But, to move their big production lines to other places than China could also imply high transaction costs, which needs time, if the whole industrial network finally changes location.

5.3. China

China played a key role in the offshoring process of the Taiwanese electronics industry. Although today both countries are in a "diplomatic conflict" on whether Taiwan is an independent State, the truth is that the Taiwanese electronics industry benefited from the less regulated environmental and labour rights from China (Olds, 2020).

Indeed, China offered preferential policies to Taiwanese firms compared to other international companies which wanted to establish their assembly lines in the country. Differently to other foreigners, Taiwanese firms did not require to enter joint ventures. Thus, in 1987, there were 20 Taiwanese firms established in Xiamen's (China) Special Economic Zone. Indeed, Xiamen boomed with a 90% of investment coming from Taiwan –which is not represented in Taiwanese economic records- (Olds, 2020). The Taiwanese businessman Terry Gou, owner of the electronics firm Foxconn, was one of the early movers to establish the speed intensive production model there.

According to Olds (2020), one of the reasons why the Chinese government welcomed Taiwanese electronic firms was to have better relations and to attach their domestic economy

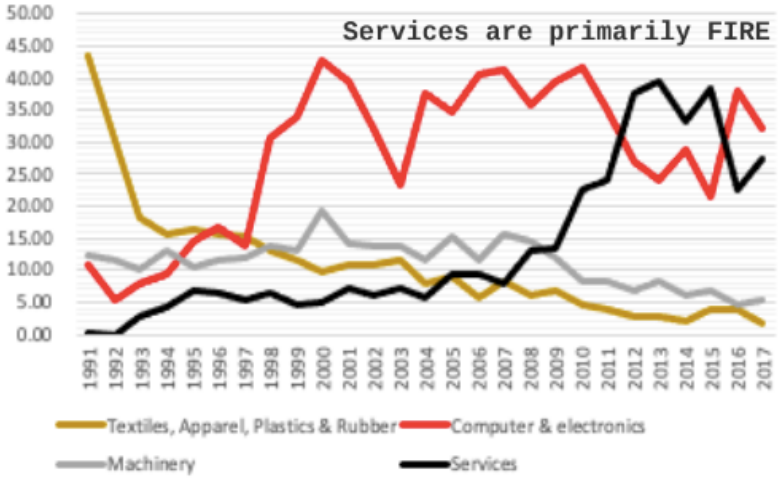
to the Chinese. Certainly, this could be a strategic way China has in mind to improve their diplomatic conflict since the war, having the ultimate goal to unify both territories.

Another interesting point to argue is that China's idea of attracting the Taiwanese electronics industry was also a way to lower the social reproduction costs in the host cities. It was known that China was suffering from overpopulation. Consequently, many local governments were willing to offer tax advantages and even to allow the demolition of villages to invite enterprises like Foxconn to be the new motor of their region. That beneficial treatment supposed the main reason why Taiwanese firms moved labour-intensive electronics abroad. But, as Taiwan's speed intensive production doubled moving to the Chinese territory, the local workforce was halved increasing unemployment. This fact explains the later situation of Taiwan moving to capital intensive products, as most developed countries do.

On the other hand, the Chinese local companies were partly damaged by the fact that they could not learn any advanced skill from the Taiwanese. Besides, they were not able to accumulate initial capital and slowed down their competitiveness. The top management from Taiwanese electronics industries were exclusively done by Taiwanese executives. Therefore, the decision-making procedure was independent from the territory where the factories were established.

Interestingly, for Taiwanese investors doing business in China with Taiwanese firms was easier to practice price transfer and to expatriate profits outside China. Transactions among firms in the network could be completed outside China, either in Taiwan or Hong Kong, to bypass the Chinese government's scrutiny (Olds, 2020). Therefore, it could be said that Taiwan's electronics industry benefited from the facilities China offered when they were opening up its economy.

Graph 5: Taiwan's Foreign Direct Investment in China (% of total). [Services are identified as Finance, Insurance and Real-Estate].



Source: Kelly Olds, Prezi named Some Finance & Investment. Subject of Market and Economic Development of Taiwan, 2020.

As it can be seen in graph 5, the early Taiwanese FDI in China was mainly done in the Textile, Plastics, Apparel and Rubber Industry at the beginning of the nineties. But, from the late nineties until the 2010s, the Computer and the Electronics Industry was the industrial sector receiving the highest capital inflow. This graph clarifies the strong economic impact Taiwan's electronics sector has steadily had during the last 30 years in China. Indeed, by 2017, although the big increase of services, the electronics industry kept its position as the leading financial output coming from Taiwanese investors.

VI. THE COSTS OF THE ELECTRONICS INDUSTRY IN TAIWAN

6.1. Externalities

6.1.1. *Domestic problems*

Nowadays, to have a dominant market share can affect not just at the level of the industry or the firm, but right down at the level of individual tasks such as assembly and packaging. Therefore, the easiness to trade a good is not constant due to the level of rivalry in international markets. Moreover, it is important to keep in mind that the tradability of a task may not be associated with the amount of skill it requires.

This statement has a strong connection with the Taiwanese speed intensive production model. So far, it has been argued that Taiwan's electronics industry does not stand out for its product's quality or exclusiveness. Its success and tradability have also occurred by external variables that favoured Taiwanese firms to be the first to run the Chinese market. For instance, the country was a pioneer to mass produce chips at a very low price. But, this was also favoured by the distinctive treatment China offered to Taiwan.

However, Taiwan's current development is being hindered by local problems. In terms of electronics, the country is suffering from deindustrialization due to the rising labour costs and the search for cheap assembly lines others than China by entrepreneurs. According to Weatherall (2020), some of its citizens prefer the country to apply protectionist policies to keep the industry inside the borders and to be less dependent from outward FDI. On the other hand, other residents argue that current salaries are too low to have a decent life. But, what really worries the future economic prospects is the low fertility rate as the country is transitioning into a super-aged society. Besides, Taiwan is suffering from a "brain drain" of young professionals moving to the USA and China.

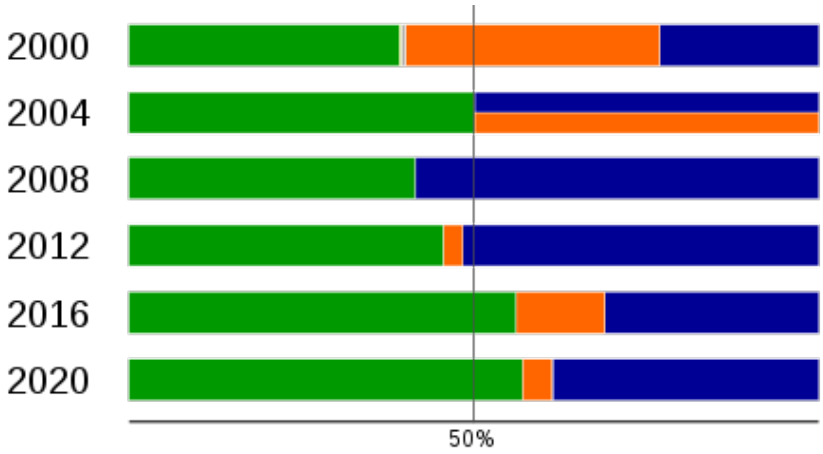
6.1.2. *Less dependence from China*

From a political point of view, Taiwan is a democracy with a two-party system. This duality is comparable to the United States of America because, even if there are several political parties eligible to vote for, only two of them have the chance to win the elections due to popular support (Weatherall, 2020). These two main political parties are the Kuomintang Party -KMT or blues- and the Democratic Progressive Party -DPP or greens-.

To summarize the difference between both, the KMT would support having close economic relations with China while the DPP would defend the Taiwanese identity and to have less dependency on China. Interestingly, as it can be seen in graph 6, during the last two election

results for the president, there was a clearer preference for the DPP party. This fact implies a higher popular support for the independence of Taiwan and its international recognition as a country not belonging to China.

Graph 6: List of presidential elections in Taiwan. [Green colour represents the DPP party while the Blue colour represents the KMT party].



Source: Wikiwand (2020). Retrieved from: https://www.wikiwand.com/en/Presidential_elections_in_Taiwan

Back in 2000, the DPP tried to push industrial diversification unsuccessfully. The green political party had the idea of moving Taiwanese factories to other developing countries located in South East Asia (Olds, 2020). It was also an attempt to limit the future political risks of maintaining Taiwanese assembly lines in China. But, it was a difficult proposal as China offered a big and cheap market as well as a similar cultural background.

Since 2012, industrial diversification is happening naturally. China is becoming more expensive as wages are rising. Furthermore, after the last financial crisis, China is planning to depend less in exports and more in State-Owned Enterprises and domestic consumption (Olds, 2020). Therefore, Taiwan is gradually moving out of China and searching for new markets in South East Asia to move its labour-intensive production.

This incident influences the current political sphere. Lately, electoral results show even more popular support towards the green party. Taiwanese society is conscious of the strong and tense ties their industrial sector has with China. Thus, the movement of their production lines to other locations, including the country itself, are strongly correlated to the DPP's influence in the government. In fact, there is a popular support for moving the national businesses' production even inside the country and to stop depending on foreign licensing.

6.1.3. *Private agents*

Apple is a representative symbol of American capital. Its model is characterized by technological innovation, design, style and marketing. Yet, these variables are boosted by the efficient work of its suppliers, like Foxconn. The centralization and concentration of capital -with Chinese rural migrant workers being the core labour force-, have contributed to Apple's and other multinational's success.

Yet, it should be taken into consideration that companies like Foxconn maintain their high market share in electronics manufacturing thanks to their millionaire contracts. Therefore, private enterprises, like Apple, influence the decision-making of their hired assembly lines. For instance, in the report of Pun et al. (2013), they mention that Apple's growth is considerably determined by the production line of its outsourcing partners. This argument is in accordance with Shih's smiling curve, which would defend the rise in value of Apple's products thanks to the job of those who perform the less valuable task. In other words, the speed intensive production line of some Taiwanese electronic firms contributes to the progress of high-end products like the iPhone.

Indeed, while the operating margins of Taiwanese enterprises like Foxconn have declined over the last years, the Apple's one still emerge although the economic crisis (Pun et al., 2013, p.105). Consequently, it is partly understandable that the squeezing plan of Taiwanese electronics firms is also caused by the pressure their potential contractors put on them. Although technology companies like Apple tend to engage in long-term relationships, they could shift contracts to other suppliers who offer better quality, lower costs and greater capabilities.

At the end, the speed intensive production model the Taiwanese enterprises once promoted is suitable for the current "neo-classical imperialism". By this term, I mean the benefits dominant multinational firms get from developing countries with few regulations on environmental and labour rights. Moreover, in the case of Foxconn and Apple, there is an asymmetrical power. Foxconn tries to retain its market position as the main producer of iPhones and iPads because that supposes its main source of revenue.

I believe that this market structure is inefficient and has strong similarities to a monopsony, in which there is a powerful buyer –Apple- having the control to purchase goods and services from many firms – like Foxconn-. The employed electronic businesses would be willing to attract their contractors in order to manufacture as many devices as possible. But, this tendency contributes to add even a higher value to Apple's finished goods compared to the electronic components from Foxconn.

6.2. Foxconn's case

The 17th March 2010, Tian Yu, a 17-year-old worker jumped from the fourth-story dorm of a Foxconn factory. She survived living paralyzed although some of her co-workers managed to take their own life. Other 14 young workers died during 2010 nearby the Foxconn facilities of Shenzhen (China). All the victims were between 17 and 25 years old (Pun et al., 2016, p.166). This tragedy from 10 years ago shows some of the negative externalities from the favourable treatment that China offered to Foxconn and other Taiwanese enterprises when moving their assembly lines in the country.

Nowadays, Foxconn stands out as a global industrial firm characterized by the speed of capital accumulation and its scale of production through China and other 28 countries, including its headquarters in Taipei. Its founder, Terry Gou, was the leader of Taiwanese Foreign Direct Investment back in the eighties. Interestingly, the foundation of the company, in 1974, was supported by an informal credit organization existing in Taiwan. In fact, Foxconn emerged from a rotating savings and credit association (ROSCA[3]) and the help of Gou's mother-in-law (Olds, 2020). The company known as "Hon Hai" just had 10 workers making TV plastic buttons. Gou did not have much success in Taiwan, and he was one of the first businessman to move its production lines in China.

That country turned to be the main centre of operations. He located Foxconn's factory in Shenzhen with 150 workers and he became incredibly wealthy. In fact, nowadays the firm's biggest production facility is still located there. There are more than 400.000 young minimum-wage workers hired with day and night working shifts. Its assembly lines operate 365 days per year to make small parts of finished products for corporate icons like Apple. According to Olds (2020), the company assembles around one half of the world's electronic products.

The core advantage of Foxconn to achieve such a success is to apply a production system called Taylorism. This one consists in the systematization of production in order to achieve the highest quality under the lowest production cost. Through this, the company increases in size and gains some market share. Yet, this strategy is not enough to lead the electronics market share. It was Terry Gou's political connections with the Chinese government which gave him some bargaining power and actually let Foxconn to rule the electronics assembly lines. For

[3] A ROSCA is made up of a group of individuals acting as an informal financial institution in the form of an alternative financial vehicle. It happens via contributions and withdrawals to and from a common fund. They are common in developing countries or immigrant groups in the developed world. Chen, J. and Brock, T. (2012): Investopedia. Retrieved from: https://www.investopedia.com/terms/r/rotating-credit-and-savings-association.asp

instance, he managed to create some factories in Chengdu (China), where 14 villages were demolished to create a 15 square kilometres' industrial space which looks more like a city than a factory. Foxconn's local officials assign worker quotas that must be fulfilled (Olds, 2020).

Figure 5: Foxconn employees working at assembly lines (China).

Source: People's Daily Online, by Zhu Xi (2015) & IPhone Hacks, by Rounak Jain (2012).

At the end, this methodology diversifies from the original creation of Taiwanese electronics industry, which started up with small companies working as networks and doing a lot of subcontracting. There was a granular production which was raised up going step by step. Yet, the 21st century electronics industry is quite different from it was before. Nowadays, it could be considered that labour-intensive production is taken to its limits in order to achieve the maximum targeted production. Therefore, environmental and labour rights are not prioritized by firms like Foxconn. Their main goal is to lead the supply of electronic components internationally.

For instance, once the media spread the scandal of Foxconn's suicides, the company needed to regain their international reputation. One of the plans to recover from that tragedy was to increase their worker's wage. But, they had to work harder instead. Their production target increased, reaching a total number of 137.000 iPhones in a 24-hour day, or more than 90 in one minute (Ngai and Chan, 2016, p.400). Therefore, Foxconn's speed intensive production is turning into a "race to the bottom" strategy in which a repressive model of management is imposed on the Chinese workforce. The hierarchy of power that Apple has towards its hired manufacturing firms of electronic pieces, like Foxconn, is reversed to the workforce. The labourers of Taiwanese electronic firms suffer the consequences from the pressures upper managers impose to reach the production target.

Curiously, in 2019 Terry Gou resigned his chairman position in Foxconn to run for president in Taiwan. After 45 years of its creation, Gou would still stay as the biggest shareholder of the company though. What did not surprise is that he was one of the candidates on behalf of the Kuomintang party -the blue-, in support of strong ties with China. Due to his success story in the mainland, he prefers to reinforce good relations with the Chinese government after the DPP party -the green- won the presidential elections in 2016. Yet, Gou defended in the media that he would not held any meeting with Xi Jinping (General Secretary of the Communist Party of China).

On the other hand, DPP members claim that Gou once said that Taiwan is part of China. To gain more popularity, he even claimed to have proposed to Apple to move the iPhone's production line from China to Taiwan. Yet, it is more likely that such production shifts to more economically appealing countries like India or Vietnam. Although he finally lost the opposition to lead the KMT for president, he remained active during the election campaign showing the Taiwanese and American flags together due to his good relations with Apple and the US president Trump.

All in all, this business case provides evidence of some factors analysed in this paper, which were affecting the Taiwanese electronics industry with the passing of time. Starting from the search for credit in informal markets, to the delocalization of Foxconn's production lines to China. This enterprise exemplifies the strategy followed by great part of the private sector once Taiwan's economy was transitioning towards a knowledge economy (see annex figure 2). Therefore, Foxconn's example contradicts my initial hypothesis, in support of speed intensive playing a secondary role for the development of the electronics industry in Taiwan.

VII. CONCLUSIONS

Taiwan's transition towards speed-intensive production in electronics started by monetary and technological transfers from developed countries like Japan and the US. The island that once was beneficial for its competitive workforce, characterized by a high female ratio, is nowadays focusing on R&D to add value to their technological advancements. Yet, during this transition, Taiwanese electronic enterprises moved abroad their assembly lines while benefiting from cheaper labour-intensive production.

In fact, I believe the speed intensity Taiwanese firms once promoted is suitable for the demand of their powerful contractors. However, the electronics industry has found some drawbacks on the path to become a leading sector. Accordingly, it is discussable to argue whether this production model is a success story at present. It is a key strategy to adapt in the current globalization period in which giant technological firms rule. Firms like Foxconn add value through the integration of their electronics components to finished products with high brand reputation.

Undoubtedly, Taiwanese electronics gets outstanding benefits from contractors like Apple to mass produce. Yet, the injured part from this agreement tend to be the employees. In this case of study, the Chinese poor regulations on labour rights have been used as the main driver for labour-intensive production as Taiwan was becoming developed. Yet, as China is currently growing and transitioning into a more developed State, it is no longer sustainable for electronic firms -like Foxconn- to maintain a squeezing strategy in Chinese lands if their goal is to lead the market share supply of electronics.

Therefore, the prospects I expect for the electronics industry is to move their assembly lines to new appealing countries like Vietnam. Yet, it is probably the case that the new hired workforce will suffer again from extended work shifts and very low wages. That manner would let capitalists to predominate if these multinational firms can apply similar unregulated practices elsewhere.

Regarding my initial hypothesis, I do not consider it is true that the speed intensive production is the main causal effect for the development of Taiwanese electronics industry. There are other relevant causes that helped the Taiwanese electronics industry to emerge. Starting from the government's support on infrastructure as well as the capitalist's entrepreneurial spirit that managed to obtain credit from informal markets. Furthermore, there was a private and public interest to invest in education, science parks and R&D.

But, there have been more reasons "behind the scenes" for Taiwanese entrepreneurs to make the electronics industry succeed. For instance, the Chinese preferential policies towards Taiwanese firms were a key factor for them to establish their production lines inside the country

and to get greater benefits than competition. They had more freedom to expand in a period of economic liberalization without the condition of forming joint ventures with Chinese officials.

On the other hand, it is true that speed intensive production's flexibility lets enterprises like Foxconn to lead the market share by a standardized production and a quick adaptation to technological changes. Although its big size in China, Foxconn still manages to reorganize its production lines and to guide logistics in very short periods of time to be the most demand-responsive as possible. But, what should be legally reformed to diminish some negative externalities affecting the environment and the labour rights are the existing structures of power between giant technological firms -like Apple- and their electronic suppliers –like Foxconn-. The high pressure the contracted firms, in this case Foxconn, face to be the most competitive manufacturers for profitable projects lead to unethical business practices. Yet, this pattern is also applicable for more sectors, beyond the electronics one, in capitalist systems.

So far, these are the conceptual results I conclude in this case of study. However, I have found some limitations during my analytical research. For instance, I have had difficulties in finding quantitative data from Taiwanese private firms in order to have an idea of annual sales, or hired employees for each factory. Moreover, there is a language barrier to get to know more information as in Taiwan or China mandarin is spoken. Therefore, for an international student in Asia, this has been an impediment to find more solid information. Luckily, at National Taiwan University, there are foreign experts studying this field. Nevertheless, I am satisfied with the obtained results and I hope this research contributes to further investigation for some interested scholars.

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IX. ANNEXES

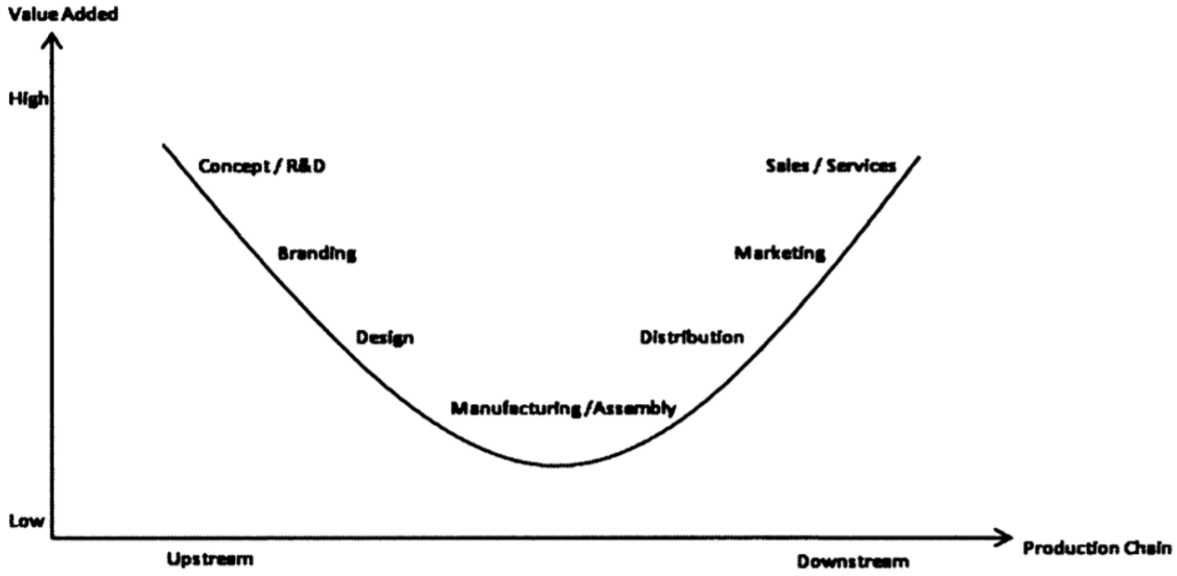


Figure 1: Smiling curve. Source from Stan Shih, Taiwan's PC Industry (2014).

	Factor input	Commercial output
1950-1970 Agricultural economy	Land, Infrastructure, Capital, Labor, Policy.	Variety, Farm, Production and management.
1970-1990 Industrial economy	Energy, Land, Raw material, Infrastructure, Capital,	Processing and export, Traditional industrial manufacturing, & OEM,
1990-2010- Knowledge economy	• Technology innovation, • Advanced technologies, • Capital intensive, technology intensive, and knowledge intensive industries, • Business network,	Integrated manufacturing, Creative intensive services, E-commerce, AI industry, Global supply chain, Globa operations center.

Figure 2: Taiwan's Economic Development Stage. Source from Jaw and Wang (2018).

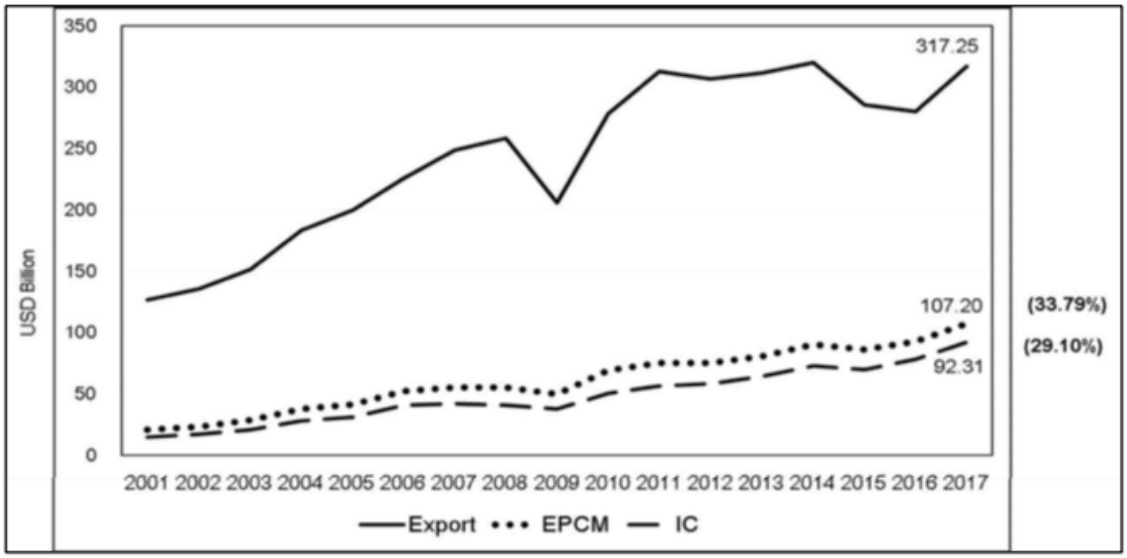
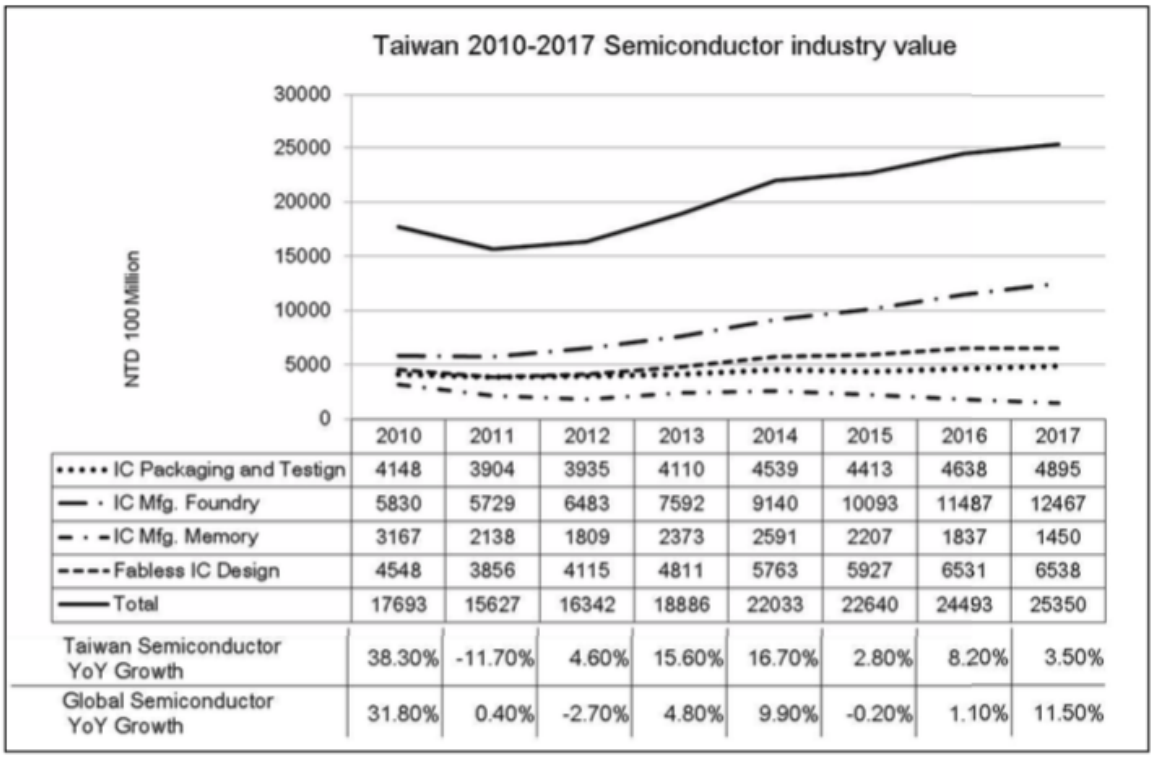


Figure 3: Volumes of Taiwan's Total, EPCM Industry and IC products exports (2001-2017). Source from the Ministry of Finance, Taiwan (2018).



	2010	2011	2012	2013	2014	2015	2016	2017
IC Packaging and Testign	4148	3904	3935	4110	4539	4413	4638	4895
IC Mfg. Foundry	5830	5729	6483	7592	9140	10093	11487	12467
IC Mfg. Memory	3167	2138	1809	2373	2591	2207	1837	1450
Fabless IC Design	4548	3856	4115	4811	5763	5927	6531	6538
Total	17693	15627	16342	18886	22033	22640	24493	25350
Taiwan Semiconductor YoY Growth	38.30%	-11.70%	4.60%	15.60%	16.70%	2.80%	8.20%	3.50%
Global Semiconductor YoY Growth	31.80%	0.40%	-2.70%	4.80%	9.90%	-0.20%	1.10%	11.50%

Figure 4: Taiwan 2010-2017. Semiconductor industry output value. Source from the Industrial Technology Research Institute (ITRI), Taiwan (2018).